Chapter 3
AFFECTED ENVIRONMENT

This chapter provides a discussion of those resource areas that may be affected by the FMP alternatives. The resources considered in this analysis include soils and geology, water resources, air quality, vegetation, wildlife and fisheries, threatened and endangered species, wilderness, noise, cultural resources, land use, socioeconomics, human health and safety, public services, park facilities/operations, and visitor use and experience.

Unless otherwise noted, the information in this chapter comes from Sleeping Bear Dunes National Lakeshore's *General Management Plan* (1979), the park's draft Fire Management Plan (1989), and its *Resources Management Plan* (2000).

3.1 NATURAL RESOURCES

3.1.1 Introduction

Sleeping Bear Dunes National Lakeshore includes over 70,000 acres (28,000 hectares), of which approximately 58,000 acres (23,200 hectares) are land surface, including two islands in Lake Michigan. About 12,000 acres (4,800 hectares) are comprised of water surface, including Lake Michigan waters and a number of smaller lakes on North and South Manitou Islands and the Michigan mainland. Pleistocene-era glaciers, glacial melt water, and subsequent wind and water erosion all shaped its landforms – including beaches, moraines, dunes, kettles and embayment lakes. Former land uses and resource exploitation or extraction have impacted the park's landforms and vegetative cover. The park's protected landscapes and vegetation communities provide sanctuary to several threatened and endangered species as well as species of flora and fauna representative of the region.

The Lakeshore's climate is strongly influenced by Lake Michigan, which among other things, moderates air temperatures in the park and its environs. The prevailing westerly winds produce milder winters (November through March) and cooler summers (June through August) are cooler near the shore than inland areas. Temperatures rarely drop below zero degrees Fahrenheit in winter or exceed 90° F in summer. The moderating effect on the air temperature combined with the local air drainage patterns result in a growing period of approximately 150 days. This compares to a growing period of 100 days several miles inland.

In the spring, Lake Michigan waters tend to lower the air temperature along the coast, reducing the incidence of early budding and frost damage. During summer, when the main storm track moves northward into Canada, differential heating between land and water areas frequently result in a lake breeze, which has a moderating, effect on air temperatures. From June through August, daily maximum temperatures are generally within the 70 to 90° F range.

During the autumn months, the warmed waters of Lake Michigan delay the onset of cold air masses moving south from Canada, allowing vegetation to mature and fruits to ripen before the first frost. Another lake effect on the Lakeshore's climate is increased cloudiness in late fall and

early winter. The cold, winter air mixing with warmer, moist air from the lake frequently produces greater amounts of snow, rain, and fog.

Average annual precipitation within the National Lakeshore is between 28 and 32 inches (711 to 813 mm). Infrequent thundershowers account for most of the summer precipitation. Measurable snowfall occurs on average of 15 days per month from December through March, with average annual snowfall totaling approximately 160 inches (4064 mm).

Prevailing winds are southwesterly, averaging about 11 mph (18 km per hour) throughout most of the year. In the fall and early winter, the prevailing direction shifts to the northwest, and in late winter to the northeast.

The Lakeshore's lake effect climate exerts a major influence on park resources and management. Vegetation communities, in particular the beech/maple forests and ephemeral flowers, are an outcome of these moist air and wind conditions. The relatively humid maritime climate also helps keep fire danger in check.

3.1.2 Geology and Soils

Landforms of the park were shaped by the continental glaciation of the Wisconsin stage as well as earlier glacial periods of the Pleistocene Era. Additionally, fluctuating water levels of the ancient lakes that preceded Lake Michigan, along with wave and wind action, caused the Lakeshore's truncated headlands and fashioned the perched dunes and embayment lakes of the park.

The glacial ice of some 50,000 years ago followed ancient drainage patterns and excavated the basins that now form the lakes along the coastal area of this region. During the final advances of the Wisconsin stage of Pleistocene glaciation, the ice deposited large terminal and lateral moraines that form contemporary dunes and high points of the local geography. Ice Age glaciers, combined with enormous quantities of melt water and huge stranded blocks of ice, created entire valleys and left kettles or ice block lakes and depressions.

As the glaciers retreated, massive volumes of water either filled the Lake Michigan basin or were drained from it – depending upon the extent of glaciation and the development of drainage channels that allowed the waters of ancient Lake Michigan (Lake Algonquin, Lake Nipissing, Lake Algoma, and Lake Chippewa) to deepen or drain away. New beaches were cut into the shorelines when the lake levels were high.

The ice sheets were one mile or more thick. After their retreat and the removal of this enormous weight, the earth began to rebound. Then waves on the lake cut beaches several feet higher than the elevation at which they were formed. As earlier levels of Lake Michigan waters were lowered, a succession of beaches was formed. These remnant beaches, examples of which can be seen at the Platte Basin, the Good Harbor Bay Region and the Bay portion of South Manitou Island, reflect the shape of the shoreline some distance from the existing shoreline. The oldest of these ancient beaches are farthest from the present lake shoreline.

Later, rising lake levels combined with wind erosion of headlands that had once resisted glacial forces, directing ice flow with its sculpting action into the lowlands, thus forming many lakes. The

steep bluffs of the National Lakeshore coastline (with such landmarks as the Empire Bluffs, Sleeping Bear Bluffs, Pyramid Point, the western bluffs of North and South Manitou Islands) are these headlands, now truncated and continually eroding through slumping and mass wasting. In 1995, more than 35 million cubic feet (about a million cubic meters) of sand from the beach and bluff at Sleeping Bear Point disappeared into Lake Michigan in a huge coastal landslide (USGS, 1998).

These headlands also provided the materials that wind and wave action transformed into the sandbars cutting off the embayment lakes (such as Platte Lakes, North and South Bar Lakes, Glen Lake, Shell Lake, and Little Traverse Lake) from the parent ancient lakes. The exposed sand and gravel in these truncated morainal headlands was separated by the winds. The sand was blown to the top of high glacial moraines and created even higher perched dunes such as Sleeping Bear Dunes, Empire Bluffs, Pyramid Point and the island dunes. Lower dunes between the headlands and moraines are found in the Platte Plains and Good Harbor areas.

The glacial activity and its resulting landforms and soil composition play a determining role along with climate in the resulting native vegetation occurring in the Park. The instability of shoreline and perched dunes contribute to the colonies of the federally threatened Pitcher's thistle (*Cirsium pitcheri*). Poorly-developed, nutrient-poor soils in sand and gravel deposits left by glaciers resulted in the rapid loss of fertility that caused farming failures. The headland bluffs (truncated moraines) perched dunes, shorelines, and embayment lakes are all products of the geology and glaciation that shaped the area and continue to influence all natural processes.

The Lakeshore’s soils are predominantly sandy or sand mixed with gravel and are well-drained. These soils are often found on steep slopes. In most areas soils are covered with a thin topsoil that was depleted in many instances by unsustainable farming practices after the land was logged in the early 1900's. Duff layers covering the soils are extremely variable ranging from none to a foot or more.

3.1.3 Water Resources

Almost one-fifth (18 percent) of the surface area of Sleeping Bear Dunes National Lakeshore consists of lake surface, including about 11,000 acres (4,400 hectares) of Lake Michigan and approximately 1,100 acres (440 hectares) of internal or interior lakes on North and South Manitou islands and the mainland. The park also contains approximately 20 miles (32 km) of streams.

Both islands contain natural lakes. The mainland units have numerous small ponds and watercourses draining into Lake Michigan. Several areas of the park contain small wetlands.

During the mid-1980's, the U.S. Geological Survey collected water quality data on the park’s waters. It was found that the Lakeshore had extremely good water quality with little or no excessive minerals or heavy metals. A biological study undertaken by the park in 1988 showed that park rivers and streams had all pollution-sensitive invertebrates present, indicating good water quality. Lake Michigan waters do have chemical pollutants present in the food chain.

3.1.4 Floodplains and Wetlands

Executive Order (E.O.) 11988 on Floodplain Management requires all Federal agencies to take action to reduce the risk of flood loss, to restore and preserve the natural and beneficial values served by floodplains, and to minimize the impact of floods on human safety, health, and welfare. Because many wetlands are located in floodplains, Executive Order 11988 has the secondary effect of protecting wetlands.

Executive Order 11990, Protection of Wetlands, states an overall wetlands policy for all agencies managing Federal lands, sponsoring Federal projects, or providing Federal funds to State or local projects. It requires Federal agencies to follow avoidance/mitigation/ preservation procedures with public input before proposing new construction projects.

In 1998, the National Park Service issued DO #77-1, establishing NPS policies, requirements, and standards for implementing E.O. 11990 (NPS, 1998b) along with a procedural manual for wetland protection (NPS, 1998c). DO #77-1 identifies the goal of "no net loss" of wetlands on national parks and commits NPS to a longer-term goal of achieving a "net gain" of wetlands in the national park system by means of restoring degraded wetlands. The procedural manual identified a number of functions and values associated with wetlands:

- Biotic Functions (e.g., fish and wildlife habitat, floral and faunal productivity, native species and habitat diversity, threatened and endangered species)
- Hydrologic Functions (e.g., flood attenuation, streamflow maintenance, ground water recharge and discharge, water supply, erosion and sediment control, water purification, detrital export to downstream systems)
- Cultural Values (e.g., aesthetics, education, historical values, archeological values, recreation, interpretation)
- Research/Scientific Values (e.g., "reference sites" for research on unimpacted ecosystems)

Approximately 20 miles (32 km) of streams that contain floodplains traverse the park on the way to Lake Michigan. The Lakeshore also contains about 750 acres (300 hectares) of wetlands, which support considerable biodiversity and certain threatened or endangered species.

3.1.5 Air Quality

The topic of air quality includes several relevant aspects, including visibility, "criteria pollutants," deposition of air pollutants, effects of wildland fires on air quality, and the specific air quality circumstances of Sleeping Bear Dunes National Lakeshore.

Visibility

Both the scattering and the absorption of light by particles in the atmosphere reduce visibility (Malm, 1999). Light transmission is inversely related to the concentration of small particles in the air. Visibility is adversely affected by very fine particulates, organics, and aerosols of nitrates and sulfates.

There is some speculation that, as a result of reduced combustion of organic matter from many decades of wildland fire suppression, and corresponding reduced emissions of particulates and other visibility-impairing pollutants, in some respects and at certain seasons air quality in the northern Midwestern states may actually be better than it was historically (MNICS, 2001). Industrial emissions and the burning of fossil fuels in stationary sources like power plants and mobile sources like motor vehicles may have largely offset any improvements in visibility. The Lake Michigan area, along with the entire eastern U.S., has witnessed a gradual degradation of visibility in the peak visitor season summer months over the last half-century (Malm, 1999).

The U.S. Environmental Protection Agency (USEPA) published final regional haze regulations on July 1, 1999 (64 FR 35714). The rules are directed at four emission sources of visibility impairment – stationary sources (industry), mobile sources (vehicles), area sources (e.g., gas stations, dry cleaners, etc.), and the use of prescribed fire. Among the pollutants most responsible for haze (i.e., nitrates, sulfates, soil material, ozone, organic carbon, and elemental carbon) the last three are found in smoke from vegetative burning or are derived from components of smoke. The goal of the regional haze program is to show continuous improvement in monitored visibility in so-called Class I areas (designated areas with good to excellent air quality that is crucial to appreciating and protecting wilderness and scenic landscapes) so that natural background conditions are restored by 2064. The rules require that each state submit a State Implementation Plan (SIP) to the EPA to implement the emissions reductions necessary to improve visibility in parks and wilderness areas.

Ozone, Particulates, and the Other "Criteria Pollutants"

Under the authority of the Clean Air Act, as amended in 1977 and 1990, the USEPA sets federal air quality standards for allowable emissions for several pollutants considered harmful to public health or the environment, including six principal or "criteria" pollutants: carbon monoxide, nitrogen oxides, ozone, particular matter, lead, and sulfur dioxide. Many of these pollutants, named above as contributors to haze, are regulated individually.

"Criteria Pollutants" for which National Standards have been set under the Clean Air Act

Carbon Monoxide (CO). CO is a colorless, odorless, toxic gas produced by the incomplete combustion of organic materials used as fuels. CO is emitted as a by-product of essentially all combustion.

Ozone (O_3). O_3 is a photochemical oxidant and a major constituent of smog. Ozone is formed when two precursor pollutants, hydrocarbons and nitrogen oxides, react chemically in the presence of sunlight.

PM_{10}. PM_{10} are fine particles less than 10 micrometers in diameter. PM_{10} includes solid and liquid material suspended in the atmosphere and formed as a result of incomplete combustion.

Sulfur Dioxide (SO_2). SO_2 is a corrosive and poisonous gas produced mainly from the burning of sulfur-containing fuel. It is also a precursor to acid precipitation.

Nitrogen Oxides (NOx). NOx are poisonous and highly-reactive gases produced when fuel is burned at high temperatures, causing some of the abundant nitrogen in the air to burn as well.

Lead (Pb). Pb is a toxic heavy metal, the most significant emissions of which derive from gasoline additives, iron and steel production, and alkyl lead manufacturing.

In addition, some pollutants (nitrogen oxides and volatile organic compounds or VOC's) react chemically to form ozone in the presence of sunlight, and others (particulate sulfates and particulate nitrates) combine to form "smog."

Deposition of Air Pollutants into Water and Soils

Certain contaminants released to the air find their way back to earth again, where if concentrated enough, they can cause environmental problems to terrestrial and aquatic systems. Mercury is an example.

Fish and wildlife in a number of areas in the northern Midwest show elevated levels of mercury in blood and tissue. This mercury most likely has its source in atmospheric pollution. Fossil fuel combustion, particularly coal-fired power plants, may be a particularly important source of mercury deposited in the park and Lake Michigan. Trends in the levels of mercury in fish and wildlife in the park have not been documented over time.

Acid deposition is a major environmental problem in certain parts of North America, such as southeastern Canada and the northeastern Untied States, which both 1) are exposed to high concentrations of sulfuric and nitric acid in rain, fog, and snow, and, 2) possess poorly-buffered rock, soils, and water. In the Canadian shield to the east and north of Sleeping Bear Dunes, for example, acid precipitation and acidified waters over the past century are considered responsible for the reduction or disappearance of some amphibians and fish. An acid rain monitoring program carried out at the Lakeshore from 1981 to 1987 indicated an average pH of 4.3 for collected precipitation, which is quite acidic. (Pure distilled water has a pH of 7.0, called "neutral," and "normal" rainwater has a pH of about 6.0, which is slightly acidic due to dissolved naturally-occurring acids. The Lakeshore's pH of 4.3 is about 40 times more acidic than normal rainwater.) This acidic rainwater would be diluted by the park's water volumes and perhaps buffered by its soils. Sources of acidifying pollution for the park are likely both regional and distant.

Wildland Fires and Air Quality

The combustion of vegetation produces various chemical compounds. These compounds include nitrogen oxides (NOx), organic compounds, carbon monoxide, and particulate matter or small particles (PM). The pollutants that affect visibility that derive from vegetative burning are PM_{10} (particles smaller than 10 microns in diameter), $PM_{2.5}$, nitrates, ozone, organic carbon, and elemental carbon. Ozone, which can form "smog" or haze, is not directly produced by fires, but from other combustion products (NOx and volatile organic compounds or VOCs). About 90 % of smoke particles from wildland and prescribed fires are PM_{10} and about 70 % are $PM_{2.5}$ (MNICS, 2001). Studies on whether forest fires may also emit small amounts of the toxic, carcinogenic compounds known as dioxins are inconclusive.

One of the main factors determining the degree of air pollution from wildland fires is smoke dispersion. Smoke dispersion is a function of ventilation, which refers to the process within the atmosphere that mixes and transports smoke away from its source. Ventilation is a function of stability, mixing height, and transport winds. Mixing height is defined as the upper limit of a mixed layer in unstable air, in which upward and downward exchange of air occurs. The

transport wind is the arithmetic average (speed and direction) of wind in the mixing layer. The Michigan lakeshore generally enjoys good ventilation during the fire weather season.

Most vegetation communities in the Great Lake States evolved with fire as a natural process for renewal and maintenance, and therefore prescribed fire is frequently utilized as a management tool in the region. Conifer forest, mixed forest, hardwood forest, savanna, grassland, brushland, wetland, and agricultural fields are all treated with fire (MNICS, 2001).

Air Quality at Sleeping Bear Dunes National Lakeshore

Some baseline air quality studies were conducted in the park during 1987 and 1988 with indications that air was of very good quality. Examination of sulfur dioxide-sensitive lichens in the park revealed very little impact from this pollutant. White pine needles showed the least damage due to air pollution of all parks tested in Michigan. The area has only light industry, and as a result has extremely good visibility most of the time. Fog from Lake Michigan is the only occasional hindrance to good visibility at Sleeping Bear Dunes.

The Clean Air Act (CAA) and pursuant regulations classified areas of the country by existing and desired air quality conditions. Sleeping Bear Dunes National Lakeshore is listed as a Class II area by Congress. Class II areas of the country are protected under the CAA, but less stringently than Class I areas, which include a limited number of specially-designated wilderness areas and national parks (such as the Grand Canyon), where outstanding visibility is critical.

With regard to the potential for the potential for smoke and air pollution from fires within the Lakeshore, on the mainland there are multiple targets or receptors. Prevailing offshore winds tend to push smoke inland to areas outside the park with extensive residential development and of high recreational value. Additionally, in spring and fall, weather patterns exist that tend to cause foggy conditions. Wildfires in the park are normally of short duration and have little effect on air quality past the initial burning period.

On the mainland, developed areas at Platte River, D.H. Day and backcountry campsites often have between 50 and several hundred people in residence. Other sensitive receptors are life estates and inholdings. Any or all of these targets could be affected by smoke produced from fires at Sleeping Bear Dunes, although past history suggests that the frequency of smoke events is extremely low. Areas most likely to be impacted by smoke are those within a thirty-degree radius of the path of any smoke plume and within the specified distances for the type and size of the fire. Critical targets of special concern are those that are within ¾ of a mile of the plume.

The park is continuing to monitor air quality. A monitoring station has been established in the park as part of the Integrated Atmospheric Deposition Network (IADN). The Lakeshore also sees a need to identify sources of air pollution in the park.

3.1.6 Vegetation

Sleeping Bear Dunes National Lakeshore's landforms, shaped by eons of glacial movement and deposits, strongly influence the distribution of vegetative communities found in the area. The temperate climate caused by Lake Michigan also affects the park's plant diversity and growth

patterns. More than 900 species of vascular plants in more than 100 taxonomic families occur at the Lakeshore (NPS, 2002a).

The landforms and characteristic plant life include beach and sand dunes, pine woodlands, oak and aspen woodlands, beech-maple (i.e. northern) hardwoods, cedar swamps, bogs, interdunal swales, aquatic zones, meadows, and the giant cedar forest on South Manitou Island.

Beaches and sand dunes are an ecosystem of harsh growing conditions characterized by strong winds, shifting sand, seasonally high surface temperatures and dry conditions. Approximately 4,800 acres (1,920 hectares) of beaches and sand dunes occur in the park. Vegetation starts just behind the "storm beach" of Lake Michigan. No vascular plants grow on the "storm beach" proper because of high waves, ice and moving sand. The first dunes behind this beach support some pioneer plants. The width of this area varies from a few hundred yards to more than a mile before encountering woods or heavier vegetation.

The plants most commonly found in the sand dunes community include beach grass, little bluestem grass, sand reedgrass, low juniper, sand cherry, beach pea, buffalo berry, red osier dogwood, smooth aster, Pitcher's thistle (on both the State of Michigan and the Federal Threatened List), and cottonwood trees. In some sites containing actively moving dunes, this zone encroaches directly onto the mature hardwood forest. More often, however, this zone integrates with an open pine forest with red pine, white pine, jack pine, creeping and common juniper, Canada wildrye and bearberry. Alternatively, it may grade into an oak and aspen woodland that is comprised of bigtooth aspen, trembling aspen, red oak, white birch and ground vegetation composed of bracken fern, prince's pine, trailing arbutus, wintergreen, blueberry, and partridge berry. Oak-aspen woods cover about 3,300 acres (1,320 hectares) of the National Lakeshore, and “coastal forest,” of which oak-pine is one subtype and birch-maple-aspen is another subtype, covers an additional 11,000 acres (4,400 hectares).

The climax forest of this region is primarily a beech-maple hardwood forest, known as the northern hardwood forest community. The trees are predominantly American beech and sugar maple, but also include black cherry, white ash, red oak, ironwood, yellow birch, and green ash. Dwarf dogwood, Canada mayflower, yellow ladyslipper, trillium, wild leeks, and fringed polygala are represented in the understory and on the forest floor. Approximately 24,000 acres (9,600 hectares), or 42% of the park’s land surface area, are covered with northern hardwood forest.

Approximately 578 acres (234 hectares) of the park are in plantations of conifers such as white pine, red pine, jack pine, Scotch pine, Austrian pine, Norway spruce, white spruce black spruce, and Douglas fir.

The fire ecology and the fire return interval of forests bordering the eastern shore of Lake Michigan are not well established (Anon., 2002). The moist maple-beech forests that predominate in the park generally appear less fire-prone or fire-dependent than jack pine and other conifer-dominated forests in the northern Great Lakes region. One recent study of upper Great Lakes coastal pine forests concluded that American Indians probably accounted for the majority of ignitions prior to Euro-American settlement in the region and later fire suppression (Loope and Anderton, 1998).

The number of forest fires and the acreage burned in Michigan dropped precipitously from the 1940's onward (MDNR, 2003b). Nevertheless, rare but extreme droughts in Michigan have produced several large, catastrophic fires over the last 130 years. For the foreseeable future, these infrequent meteorological episodes can be expected to recur, bringing sharply increased risk of major wildland fires, a situation exacerbated by fuel accumulation from years of suppression.

The Lakeshore also contains a small number of classic bogs with good examples of floating mats. The plant species of these bogs include sphagnum moss, black spruce, water sedge, cottongrass, speckled alder, pitcher plant, Labrador tea, bog laurel, leatherleaf, cranberry, and sundew.

Interdunal swales are the low areas between the ancient beach ridges that remain wet much of the year. They contain an association of rushes and sedges, willows, gray dogwood, Joe-pye weed, and cardinal flower.

Other aquatic zones contain plants that may be submerged, emergent, or floating. These wet areas of the park are found along streams, or in shallow lakes and ponds. Plants include cattail, pondweeds, arrowhead, bulrushes, sedges, coontail, yellow pondlily, white waterlily, grass-of-parnassus, marsh cinquefoil, fringed gentian, and bladderwort. The park contains about 750 acres (300 hectares) of wetlands in total.

The park includes open areas consisting of abandoned farm fields and road edges; many of these fields are cultural landscapes, and will be managed as cultural landscapes in the future. The plants usually found in these areas include black-eyed Susan, ox-eye daisy, goldenrod, pussytoes, pearly everlasting, star thistle, hawkweed, chicory, yarrow, bladder campion, St. John's wort, common milkweed, staghorn sumac and several grasses. Fields cover almost 7,900 acres (3,160 hectares) of the park, or about 14% of its land surface area.

The giant cedar forest on South Manitou Island is especially noteworthy. This small area (less than 10 acres or four hectares) of virgin giant cedars escaped logging. One of these trees is the largest northern white cedar in the United States, at 110 feet (33 meters) tall with a girth of 206 inches (523 cm). Many of these cedars are over 500 years old. Other species in this area are mountain maple, striped maple, red trillium, and four rare ferns (walking fern, green spleenwort, northern holly and Braun's holly fern). The Gleason trillium grows in this area also and hybridizes with the red trillium to form many variations.

The park has embarked on a cooperative program with the U.S.G.S. Biological Resource Division to survey and assess exotic species in the park. At least 150 exotic or non-native plants or noxious weeds have been identified at Sleeping Bear Dunes. Some of the more invasive exotic plants in the park are garlic mustard, leafy spurge, purple loosestrife, and baby's breath. The park has developed a "hit list" for these four plants and five others – black locust, common reed, myrtle, Scotch pine, and the tree of heaven or ailanthus (SLBE, 1999).

3.1.7 Wildlife and Fisheries

Michigan wildlife is well-represented at Sleeping Bear Dunes, reflecting the variety of habitats found within the park. The following numbers of vertebrates have been documented as present at the Lakeshore:

- Fish – 74 species and/or sub-species in 17 families, including the lake sturgeon, bowfin, alewife, suckers, redhorses, chubs, carp, shiners, dace, minnows, bass, killifish, mudminnow, burbot, stickleback, smelt, sunfsh, blugill, darters, perches, walleye, muskellunge, pumpkinseed, crappie, perch, lampreys, lake herring, sculpins, salmon, whitefish, trout, bullheads, and channel catfish (NPS, 2002b).

- Amphibians – 18 species and/or sub-species in seven families, including toads, frogs, treefrogs, salamanders, newts, and the mud-puppy (NPS, 2002c).

- Reptiles – 17 species and/or sub-species in five families, including snakes, one species of skink, and turtles (NPS, 2002d).

- Mammals – 46 species and/or sub-species in 17 families, including the white-tailed deer, coyote, red fox, house cat, river otter, weasels, mink, raccoon, black bear, bats, opossum, shrews, moles, rabbits, snowshoe hare, jumping mouse, voles, muskrat, deer mice, flying squirrels, squirrels, woodchuck, and chipmunk (NPS, 2002e).

- Birds – 247 species in 38 families, including ducks, geese, swans, mergansers, hawks, owls, osprey, bald eagle, herons, egrets, plovers, vultures, loons, terns, gulls, cormorant, sandpipers, turnstones, woodcock, cuckoos, rails, waxwings, wild turkey, ruffed grouse, wrens, gnatcatcher, horned lark, brown creeper, warblers, vireos, blackbirds, finches, sparrows, juncos, orioles, swallows, thrushes, American robin, nuthatches, flycatchers, woodpeckers, kingbirds, whip-poor-will, and common nighthawk (NPS, 2002f).

Beaver, otter, mink, and muskrat occur in the park's aquatic areas. Ducks and geese nest at the Lakeshore. Snapping turtles, painted turtles, leopard frogs and spring peepers are some of the other reptiles and amphibians found in and near aquatic and wetland habitats.

Common forest wildlife includes the white-tailed deer, red fox, raccoon, fox squirrel, flying squirrel, eastern chipmunk and the woodland deermouse. Typical forest-dwelling birds are the ruffed grouse, pileated woodpecker, downy and hairy woodpeckers, red breasted and white-breasted nuthatches, chickadees, brown creepers, myrtle warblers, ovenbirds, red tailed hawks, barred owls and great horned owls. Wild turkeys are also present. Garter and ringneck snakes occur in the forest, as do salamanders.

In the meadows, fields, and dunes of the National Lakeshore, representative birds include bobolinks, bluebirds, killdeer, meadowlarks, horned larks, upland plovers, and marsh hawks. Common mammals are deer, fox and meadow voles. The park's open fields (several abandoned farms) now provide valuable habitat for grassland nesting birds in the summer and for other wildlife throughout the year. This habitat is maintained with an open field management (meadow management) late-season mowing plan. In the absence of cultivation and grazing, grassland bird species in national decline such as Savannah sparrows, grasshopper sparrows, vesper sparrows, bobolinks, and upland sandpipers, flourish in these meadows. The National Lakeshore's 160 species of nesting birds is greater than any other NPS unit. This is because of the wide variety of undisturbed habitat and the lack of agriculture, grazing, and major development. The park is an important area for the protection of nesting sites for vulnerable bird species and for stopover sites

and resting for migratory birds. Shorebirds like the semi-palmated plover, ruddy turnstone, sanderling, spotted sandpiper and others can be found on park beaches.

The North and South Manitou Islands are an interesting case study in "island biogeography"; as would be expected, they support fewer species of wildlife than nearby mainland areas. The seven miles (11 km) of water (Lake Michigan) between the islands and the mainland is a substantial barrier to animal migration has been a major factor in the island ecology and species presence or absence.

South Manitou Island has dense ground vegetation rich in woodland wildflowers and Canada yew. The vegetation developed in the absence of deer browsing. In 1994 however, deer tracks were observed for the first time. Their presence threatened the natural vegetation composition of this island and they were removed in 2001. New deer tracks were reported on South Manitou Island in 2003. These migrants probably came from North Manitou Island. The woodland deermouse is the only mouse species, compared to seven species of mice and voles on the mainland. Eastern chipmunks and fox squirrels are found on South Manitou Island but none of the other tree squirrels (red and gray squirrels, and two species of flying squirrels).

The masked shrew has been collected on South Manitou Island, but not the short-tailed shrew (found on the mainland). Reptile and amphibian species are also limited. Leopard frogs, spring peepers, American toads, painted turtles, ringneck snakes and garter snakes may all be observed on South Manitou Island.

South Manitou Island's bird life is rather diverse, with many migrating birds and woodland residents. The ruffed grouse, however, is not found on this island. There was a large ring-billed gull colony on South Manitou as well as a herring gull colony. The future of the rookery is in doubt because of continued red fox predation, and indeed the rookery failed in 1990 and 1991. The ring-billed colony has returned recently and there were an estimated 13,000 nests in 1998. It is unusual for gulls to nest in a location of mammal predation and it is thought that the gull colonies developed during short periods when the number of fox were severely reduced or was eliminated by island settlers. The fox population has declined in recent years and the snowshoe hare population has also increased.

The wildlife found on North Manitou Island is similar to South Manitou Island except that white-tailed deer, raccoons and wild turkey were all introduced in the 1920's while the island was a private hunting preserve. The deer herd exceeded the natural carrying capacity of the island because of an enormous artificial feeding program. As a result, North Manitou's vegetation displayed classic symptoms of overbrowsing. Natural browse was almost entirely eliminated and sharp browse lines are evident at the limit to which deer can reach. For a number of years, deer starved on the island because the artificial feeding program favored bucks and large does, leaving many of the young deer to die. South Manitou Island's luxuriant understory and ground cover vegetation do not occur on North Manitou Island.

In response to this deer overpopulation and subsequent habitat degradation, the Lakeshore initiated an intense public hunting program in 1985 to reduce deer numbers and restore natural native vegetation. The annual public deer hunt continues every autumn, under regulation by the State of Michigan and the NPS.

In the park as a whole, trapping is prohibited. As a result, sightings of fox, coyote, otter and bobcat have increased in the years since trapping was banned. In recent years, cougar sightings have been made with increasing regularity.

Sleeping Bear Dunes National Lakeshore's aquatic habitats contain a number of fish species, including rainbow and brook trout, suckers, shiners, rock bass, perch, sunfish and bluegills. Smelt, sea lamprey, alewife, and now zebra mussels, are exotic or non-native species that have a pronounced impact on the aquatic environment and native biota. The invasion of the sea lamprey, an exotic species to the Great Lakes, has harmed the native lake trout stock. The alewife invasion of the Great Lakes has also caused major biological and shoreline fouling problems.

The introduction of the coho and other species of salmon to the area has resulted in a large seasonal supply of these fish in area streams, providing for a large sport fishery every late summer and fall. Fishing for coho salmon is concentrated near the mouth of the Platte River and Platte Bay but sport-fishing activity occurs in other bays of Lake Michigan and also in the inland lakes.

Aquatic insects in the park's clear waters include larval stages of the mayfly, black fly, crane fly, dragonfly, caddis fly, stonefly, midges and mosquitoes. Other insects are water bugs (whirligig beetles), water boatmen and backswimmers.

3.1.8 Threatened and Endangered Species

The Endangered Species Act of 1973 prohibits the harming of any species listed by the U. S. Fish and Wildlife Service (USFWS) as being either threatened or endangered. Harming such species includes not only directly injuring or killing them, but also disrupting the habitat on which they depend. Section 7 of the Act also requires Federal Agencies to consult with the Fish and Wildlife Service when any activity permitted, funded, or conducted by that agency may affect a listed species or designated critical habitat, or is likely to jeopardize proposed species or adversely modify proposed critical habitat.

Table 2 displays federal and state listed species (threatened, endangered species concern) whose occurrence has been documented in Benzie County and Leelanau County, the two counties in which Sleeping Bear Dunes National Lakeshore occurs (MNFI, 1999). These species may thus be expected to occur within the National Lakeshore itself.

Table 2 – Federal and State-listed Species Likely to Occur at Sleeping Bear Dunes National Lakeshore

Scientific Name	Common Name	Type	State Status	Federal Status
Accipiter gentiles	Northern goshawk	A	SC	
Acris crepitans blanchardi	Blanchard's cricket frog	A	SC	
Adlumia fungosa	Climbing fumitory	P	SC	
Amerorchis rotundifolia	Round-leaved orchid	P	E	
Asplenium rhizophyllum	Walking fern	P	T	
Barula erecta	Cut-leaved water-parsnip	P	T	

Scientific Name	Common Name	Type	State Status	Federal Status
Botrychium campestre	Prairie moonwort, dunewort	P	T	
Bromus pumpellianus	Pumpelly's brome grass	P	T	
Buteo lineatus	Red-shouldered hawk	A	T	
Calypso bulbosa	Calypso or fairy-slipper	P	T	
Carex concinna	Beauty sedge	P	SC	
Charadrius melodus	Piping plover	A	E	LE
Cirsium pitcheri	Pitcher's thistle	P	T	LT
Clemmys insculpta	Wood turtle	A	SC	
Cypripedium arietinum	Ram's head lady's-slipper	P	SC	
Dendroica discolor	Prairie warbler	A	E	
Gavia immer	Common loon	A	T	
Haliaeetus leucocephalus	Bald eagle	A	T	PS; PDL
Lanius ludovicianus migrans	Migrant loggerhead shrike	A	E	
Martes americana	American marten	A	SC	
Microtus pinetorum	Woodland vole	A	SC	
Mimulus glabratus var. *Michiganensis*	Michigan monkey-flower	P	E	LE
Notropis anogenus	Pugnose shiner	A	SC	
Orobanche fasciculata	Fascicled broom-rape	P	T	
Panax quinquefolius	Ginseng	P	T	
Pandion haliaetus	Osprey	A	T	
Pterospora andromedea	Pine-drops	P	T	
Stagnicola contracta	Deepwater pondsnail	I	T	
Stenelmis douglasensis	Douglas stenelmis riffle beetle	I	SC	
Tanacetum huronense	Lake Huron tansy	P	T	
Terrapene Carolina Carolina	Eastern box turtle	A	SC	
Trimerotropis huroniana	Lake Huron locust	I	T	
Triphora trianthophora	Three-birds orchid	P	T	

Key to symbols: *A = vertebrate animal; I = invertebrate animal; P = plant; State Status: E = endangered; T = threatened; SC = special concern; Federal Status = LE = listed endangered; LT = listed threatened; PS = partial status (federally listed in only part of its range); PDL = proposed delist*

Four Federal-listed species are documented in the two counties where Sleeping Bear Dunes National Lakeshore is located, two of which are animals and two of which are plants. The peregrine falcon (*Falco peregrinus*), which is found in the park, was listed as an endangered species in 1970, but was de-listed in 1999 as a result of recovery of its populations from successful efforts at captive breeding and reintroductions (TPW, 1999; WDFW, 2002).

Of the four currently listed species, the piping plover and Michigan monkey-flower are both federally endangered, while the Pitcher's thistle and bald eagle are federally threatened. Each is described briefly in turn.

- **Piping plover** (*Charadrius melodus*) – The piping plover is a small shorebird (length about seven inches) with a black collar, orange legs and a short, stubby tail (USGS, 2000). In the Great Lakes region, piping plovers nest on sparsely vegetated beaches, cobble pans, or sand spits of sand dune ecosystems along lake shorelines (USFWS, 2001a). Listed by the USFWS as endangered in 1985, this bird is in trouble throughout its range because of the loss and degradation of natural riparian habitat, nest disturbance and predation. Many of the riverside beaches and sand dunes traditionally used by piping plovers for nesting have been lost to river channel modifications (USFWS, 2001b). Many of the coastal beaches traditionally used by piping plovers for nesting have been lost to commercial, residential, and recreational developments (USFWS, 2000). In addition, piping plovers are very sensitive to the presence of humans. Too much disturbance from people or their pets causes the parent birds to abandon their nest.

  The U.S. Fish and Wildlife Service has designated critical habitat for the piping plover along certain shorelines within the Lakeshore, including two miles (3.3 km) along North Manitou Island and 14.2 miles (22.5 km) along the mainland lakeshore within the park (DOI, 2001); these are areas that must be protected because they are considered essential to the conservation of the Great Lakes breeding population of the species.

- **Michigan Monkey-flower** (*Mimulus glabratus* var. *michiganensis*) – The Michigan monkey-flower is a variety of the monkey-flower that is listed both by the federal government and the State of Michigan as endangered. In 1990 the USFWS designated it as endangered over its entire range (USFWS, 2002a; USFWS, 1990). This plant grows in muck and sand that is either saturated or covered by cold, flowing spring water. Almost every known population of the monkey-flower occurs near present or past shorelines of the Great Lakes (USFWS, no date-1).

  The main threats to aquatic and semi-aquatic species occur from recreational and residential development. Increased construction and development along lakes and streams has eliminated monkey-flower habitat, including three known populations of the flower. Because it needs flowing spring water, road construction and other ground-disturbing activities that affect water drainage also adversely impact the species. Michigan monkey-flowers now survive at only 12 sites in Michigan, two-thirds of which are on private property. A population of the Michigan monkey-flower occurs within the Lakeshore (USFWS, 1990).

- **Pitcher's thistle** (*Cirsium pitcheri*) – Pitcher's thistle is a native thistle that grows on the beaches and grassland dunes along the shores of Lakes Michigan, Superior, and Huron (USFWS, no date-2). Residential and marina development along with associated landscaping directly removes Pitcher's thistle and its habitat within the footprint of the construction. Such development also fragments remaining populations and dune habitats. In addition, increasing human vehicular and foot traffic along shorelines is problematic. Pedestrians and Off Road Vehicles (ORVs) trample Pitcher's thistle, which harms or destroys the plants. ORV traffic among dunes also causes erosion, which in turn creates unstable areas difficult for plants to take root in. Pitcher's thistle and its dune habitat are also eliminated by the creation and maintenance of public beaches. In 1988, Pitcher's

thistle was designated as threatened throughout its entire range (USFWS, 2002b; USFWS, 1988).

- **Bald Eagle** (*Haliaeetus leucocephalus*) – The bald eagle is also listed as threatened by the State of Michigan. However, the USFWS may de-list this bird as a result of its increasing numbers around the country (USFWS, 2001). The reason for historic declines in bald eagle populations in the 1950's and 1960's included PCBs, DDT, DDE, mercury, and disturbance and displacement by humans. DDT was the primary cause and the banning of DDT in the early 1970's has led to a resurgence in numbers throughout the U.S. as well as the Great Lakes region. Since its primary diet consists of fish, bald eagles tend to feed, roost and nest near water bodies.

Thirty-three species are listed as endangered, threatened, or special concern by the State of Michigan Department of Natural Resources (MDNR). These species and sub-species are not afforded the same formal protection provided by the federal Endangered Species Act, but they are monitored and may one day become candidates for the Federal list, if their numbers continue to trend downwards. Five species are listed as state endangered (two plants, three vertebrate animals), 17 are listed as state threatened (11 plants, four vertebrate animals, two insects), and 11 as special concern species (four plants and seven vertebrate animals).

The park's diverse habitats are the reason for the many species of rare or special interest plants in the park. The fragile habitats of dunes, wetlands and shade forests are of interest because of the presence of some of these rare plants. Species that are rarely observed include Ram's-head lady slipper, three-birds orchid, broomrape, pine drops, walking fern, and ginseng. A newly discovered botrychium or dunewort (*Botrychium* sp. nov.) was first located in the dunes of the park. Michigan holly is found in the wetlands and there are many other orchids and trilliums in the park forests.

3.1.9 Wilderness

The 1964 Wilderness Act defines "wilderness" as a place where natural forces, not human ones, predominate. Analysis and planning efforts in the 1970's and 1980's concluded that approximately 30,000 acres (12,000 hectares) at the Lakeshore, in five distinct areas on the islands and mainland, were determined as Recommended or Potential Wilderness. The NPS documented this wilderness recommendation, but to date Congress has not formally designated any of these areas as wilderness. In a 1982 congressional amendment to park enabling legislation (P.L. 97-361), it was stated that these lands were to be administered to maintain their wilderness character, until Congress determines otherwise.

As a result, these areas recommended by the NPS as wilderness are administered so as not to compromise their suitability for eventual designation. They are managed for the long-term protection of wilderness character and values until such time as Congress takes action. Only non-motorized recreation is permitted within proposed wilderness areas.

The NPS may take no action that would diminish the wilderness suitability of an area recommended for wilderness designation until the legislative process has been completed. Until then, management decisions about recommended wilderness will be made in expectation of

eventual wilderness designation *(Management Policies,* "Wilderness Preservation and Management," section 6.3.1, 2001).

Management as wilderness includes applying the concept of "minimum requirements," such as "minimum tool" use to accomplish management actions. It also seeks to remove any existing non-conforming conditions that might preclude wilderness designation.

3.1.10 Noise

Noise is defined as unwanted sound (INCE, 1995). The particular pattern (location, duration, timing and frequency) of human activities gives rise to a perception of noise. The loudest sounds that can be detected comfortably by the human ear have intensities that are 1 trillion (1,000,000,000,000) times larger than those of sounds that can just be detected. Because of this vast range, any attempt to represent the intensity of sound using a linear scale becomes very unwieldy. As a result, a logarithmic unit known as the decibel (dB) is used to represent the intensity of a sound. Such a representation is called a sound level. The loudness of sound as heard by the human ear is measured on the A-weighted decibel (dBA) scale. Normal speech has a sound level of approximately 60 dBA. Sound levels above about 120 dBA begin to be felt inside the human ear as discomfort and eventually pain at still higher levels (Department of Defense (DOD), 1978). Examples can be found in Table 3.

Table 3 – Common Noise Levels and Their Effects on the Human Ear

Source	Decibel Level (dBA)	Exposure Concern
Soft Whisper	30	Normal safe levels
Quiet Office	40	
Average Home	50	
Conversational Speech	66	
Busy Traffic	75	May affect hearing in some individuals depending on sensitivity, exposure length, etc.
Noisy Restaurant	80	
Average Factory	80 - 90	
Pneumatic Drill	100	Continued exposure to noise over 90 dB may eventually cause hearing impairment.
Automobile Horn	120	

(DOD, 1978)

Certain land uses, facilities, and the people associated with these noise levels are more sensitive to a given level of noise than other uses. Such "sensitive receptors" include schools, churches, hospitals, retirement homes, campgrounds, wilderness areas, hiking trails, and some species of threatened or endangered wildlife. Recommended land use and associated noise levels are illustrated in the following table (Table 4). The only land use category in the table below that is well-represented within Sleeping Bear Dunes National Lakeshore is "Natural Recreation Areas."

However, just outside the park's boundaries, residential, commercial, agricultural, and institutional also occur in a number of locations.

Table 4 – Recommended Land Use Noise Levels

Land Use Category	Noise Levels			
	Clearly Acceptable	Normally Acceptable	Normally Unacceptable	Clearly Unacceptable
Residential	< 60	60-65	65-75	> 75
Commercial, Retail	< 65	65-75	75-80	> 85
Manufacturing	< 55	55-70	70-80	> 80
Agriculture, Farming	< 75	> 75		
Natural Recreation Areas	< 60	60-75	75-85	> 85
Hospitals, Schools, Libraries, Churches, Nursing Homes	< 60	60-65	65-75	> 75
Playgrounds	< 55	55-65	65-75	> 75

(HUD, 1991)

In recent decades, noise has become a controversial issue in certain national parks, as many parks that retain their historic appearance no longer sound as they once did, due to the widespread proliferation of motorized and human-generated noise from a variety of sources across the American landscape. In response, NPS management policies call for the preservation of, "to the greatest extent possible, the natural soundscapes of parks" (NPS, 2000; Section 4.9). Human activities that generate noise are to be monitored, and it is NPS policy to prevent or minimize noise that affects the natural soundscape or exceeds levels appropriate for visitor uses. Section 8.2.3 of the 2001 *Management Policies* directs the NPS to "strive to preserve or restore the natural quiet and natural sounds associated with the physical and biological resources of parks." Where use of motorized equipment is necessary and appropriate, the "least impacting" equipment and vehicles should be used, consistent with public and employee safety.

Some conservationists argue that auditory solitude, that is "quietude," was recognized by the drafters of the 1964 Wilderness Act and is implied by the act's language (Matzner, 2001). NPS policy on wilderness management explicitly recognizes the incompatibility of man-made noise with wilderness. Since 30,000 acres (12,000 hectares) of the park is proposed for wilderness designation, and managed so as not to impair its wilderness attributes, Lakeshore management must consider potential impacts of motorized equipment to the character, esthetics, and traditions of wilderness (NPS, 2000; Section 6.3.4.3). Throughout North America as a whole, the limited research and surveys to date into attitudes of backcountry users toward mechanical and other human noise (loud voices, rowdiness, radios and other sources of recorded music, etc.) do suggest that noise can be annoying and interfere with visitor experience (Gramann, 1999).

In addition to intruding on wilderness solitude, another potential impact of human and motorized noise is on wildlife. Some scientists believe that around the world, noise pollution is contributing to the depletion of wildlife populations, although this is very difficult to quantify

and has not been documented at the Lakeshore in particular. Research into the effects of noise on wildlife has been growing rapidly since the 1970s, yet often presents contradictory results because of the complexity of factors and the difficulty of isolating variables; nevertheless, most researchers agree that noise can affect an animal's physiology and behavior, and if it becomes a chronic stress, can be detrimental to an animal's energy budget, reproductive success and long-term survival (Radle, 1998). The long-term effects from medium to low-level noise intrusion need much more research, with emphasis on threatened and endangered species. The synergistic effects of noise with other stressors on animals also need investigation (Cornman, 2001).

Sources of noise at the Lakeshore include motorboats, auto traffic along county, state and park roads, airplanes passing overhead, chain saws, snowmobiles, and miscellaneous equipment. The configuration of the park subjects virtually every portion of it to some level of intrusive, mechanical noise; the Lakeshore does not have a pristine acoustic environment. However, neither is it exposed to the degree of persistent or prolonged artificial noise that certain other units of the national park system are.

3.2 CULTURAL RESOURCES

Archaeological evidence suggests that some of the earliest human habitation of the Sleeping Bear Dunes National Lakeshore area occurred during the Late Archaic period, 3000 BC to 600 BC. Numerous distinct cultures appear to have been the predecessors of the Ojibwa, Ottawa, Potawatomi, and Miami (Watson, 2003). The Lakeshore area was used by these prehistoric people on a seasonal basis, a pattern of seasonal use that was continued in more recent times by the Ottawa and Chippewa, of the western Great Lakes region. These tribes primarily visited the park area for the purpose of hunting and fishing. Their attachment to the area gave rise to legends about its natural features, the most famous of them concerning the "Bear Lying Down" (the Sleeping Bear Dune) and the sanctity of the Manitou Islands.

The early 17th century provides some of the first records of Native American life in the Great Lakes region. French explorers recorded that corn was the principal crop of the Ottawa and Huron Indians inhabiting the region, with peas, beans, squash, and a plant identified by the French as “melons” also being cultivated. Crops were grown in plots adjacent to summer villages inhabited by several bands of Indians. Seasonal hunting and gathering continued to play an integral role in the summer and winter settlement patterns for tribes in the region, but the fur trade between Indians and Europeans had begun to cause profound changes in Indian society.

Intertribal war, changing trade alliances, resource degradation and resource access issues led to numerous resettlements of Native American tribes. The Potawatomis, unlike the Ottawas and Ojibways, moved further west and south, eventually relocating to an area between the present-day cities of Milwaukee and Detroit, and into northern Indiana and central Illinois. During the 19th century, while many bands of Potawatomis were relocated to Iowa and Kansas, some moved to Oklahoma and others to Canada – a few groups also remained in Michigan. The Ottawas and Ojibways maintained closer alliances and traditional associations in the Sleeping Bear Dunes and Grand Traverse region. Between about 1720 to 1761, the Ottawas made settlements in the vicinity of present-day Sleeping Bear Dunes National Lakeshore, establishing themselves along the waterways (Watson, 2003).

The 19th century marked continuing challenges and changes in the lifeways and settlement patterns of the Ojibways and Ottawas. The narrow passage between the Manitous and the mainland – a reliable transportation gateway – brought fishermen, trappers, loggers and settlers to the region. This influx of Euro-Americans resulted in the establishment of maritime commerce, a rapid-growing timber industry, and resulting changes in the environment and ecosystem. Euro-Americans eventually occupied tribal winter hunting grounds, and in the 1836 Treaty of Washington, the Ottawa relinquished claim to the northwestern third of Michigan's Lower Peninsula, opening the Sleeping Bear Dunes area to Euro-American settlement. In the following year Michigan became a state and regular steamboat service was established on Lake Michigan (Watson, 2003).

Human activities associated with the settlement of the region in which Sleeping Bear Dunes National Lakeshore is situated are reflected in many of the surviving historic structures and former farm fields around the park. More than 350 historic structures in the park are eligible for the National Register of Historic Places (PHSB, 1999). The Lakeshore landscape includes historic farmsteads, barns, outbuildings, inns, cottages, schoolhouses, log cabins, lighthouses, and open fields. Many of these fields are cultural landscapes, and will be managed as cultural landscapes in the future.

The area's maritime history is represented by U.S. Life Saving Service Stations located at Glen Haven (1902-1941) and South Manitou Island (1901-1958). Farms on the islands and the mainland signify the area's agricultural history; surviving farm-related structures include the D.H. Day farm and barn, the Esch farm and the historic farm district near Port Oneida, the Hutzler and Beck farms on South Manitou Island, and the Swenson barn on North Manitou Island.

Sites significant to the area's logging history are found at Aral, Good Harbor, and Glen Haven (with the Sleeping Bear Inn and logging railway). A number of other sites and evidence found on the islands and the mainland also possess historic significance. The D.H. Day Campground is the first state campground in Michigan. Early examples of summer recreation and resorts in Michigan are found also in the Sleeping Bear Inn at Glen Haven.

The westward expansion of the American frontier into the Old Northwest Territory in the early 1800's was responsible for the onset of commercial shipping on the western Great Lakes. Lake Michigan became a major artery, and the Manitou Passage (between South Manitou Island and the mainland eight miles to the east) a valuable shipping lane. The importance of this passage was recognized early on, and in 1840 the U.S. Lighthouse Board erected a lighthouse on South Manitou Island, which had the only natural harbor of refuge between the straits of Michilimackinac and Chicago. The continuing value of the Manitou Passage for navigation on Lake Michigan led to the improvement and expansion of the lighthouse system and to the establishment of lifesaving stations to assist ships that ran aground or sank.

The introduction of steamships to the Great Lakes in the early 1800's was an important development for lake transportation, and led to the initial settlement of the Sleeping Bear Dunes area. In about 1835, a cordwood dock was established on South Manitou Island, signaling the first known permanent settlement of that island. A decade later a similar operation was started on North Manitou Island, and in the late 1850's wooding stations were established on the mainland.

Glen Haven's primary significance is as a steamship stop. Lumber is secondary, along with orchards and recreational uses.

Not long after the cordwood docks were located in the vicinity of Sleeping Bear Dunes, other pioneers including fishermen, merchants, farmers, and loggers, began to settle in the area. The lumber industry grew rapidly and became the economic mainstay of the area, a position it held until the eve of World War I. Most of the logging occurred on the mainland and on North Manitou Island. Small communities sprouted up around the sawmills that were developed throughout the area.

Early settlers in the Sleeping Bear Dunes area discovered that conventional farming was difficult because of the easily-exhausted, infertile sandy soils. However, farmers learned that the particular climate and temperature regime of Lake Michigan's eastern shore were favorable to fruit trees. Thus, the number of orchards multiplied after the turn of the last century. Cherries were the dominant fruit. Fruit production became an important part of the neighboring economy.

Both settlers and visitors had long recognized the natural beauty of the area's islands, beaches, dunes, Lake Michigan waters, and inland lakes. Early in the 20th century tourists began to arrive in large numbers. At first they patronized established resorts, but after World War II many of those who enjoyed the beauty and solitude of the area began to build summer homes and cottages. This influx of tourists and summer residents brought renewed vitality to some of the former sawmill towns, rescuing them from gradual decline and perhaps eventual disappearance.

Today, the Lakeshore's remaining historic structures are at risk from further deterioration and decay. While the park is attempting to stabilize, preserve, and restore its historic structures, this is a huge task (PHSB, 1999). Some of the buildings are destined for re-use and leasing by partners and others preserved for visitor tours.

While archeological inventories at the Lakeshore are incomplete, there are considerable data available to understand the distribution of archeological sites across the park. Certain landforms and topographic settings contain most of the known prehistoric sites. Therefore, even where inventory coverage is sparse, there are data available to predict where other sites are likely to occur. Extensive acreage within the park is therefore not expected to contain any prehistoric archeological sites. Historic sites are more widely distributed (especially in the uplands) than prehistoric sites, but many of the "unrecorded" prehistoric site locations can be predicted from historic maps and other documents.

Today there are several Native American communities with known or potential traditional associations with Sleeping Bear Dunes National Lakeshore. With further research, study and consultation, it may be found that various Euro-American communities or community members ascribe traditional values to resources within the park, especially those places closely linked with a group's sense of purpose or existence as a community. Such communities might include the New Englanders, Irish, Scandinavians, French or Germans. Other user-groups might include farmers, maritime communities and others. Those Native American groups with traditional associations include, but are not limited to, the Grand Traverse Band of Ottawa and Chippewa of Michigan, Bay Mills Indian Community of the Sault Ste. Marie Band of Chippewa Indians,

Little River Band of Ottawa, Ottawa Tribe of Oklahoma, and Little Traverse Bay Bands of Odawa Indians of Michigan.

Several categories of ethnographic resources important to Native Americans (e.g. Ottawas, Ojibways and Potawatomis) have been identified within Sleeping Bear Dunes National Lakeshore. Many of these natural and cultural resources may be significant for the preservation of traditional cultural practices among Native Americans who are affiliated with the park.

While complete ethnographic surveys and inventories are not yet available for the park, recent research and fieldwork with traditionally associated Native Americans documented important sacred and traditional resources in four specific areas of the park. These important data about the ethnographic dimensions of the landscape combined with the archeological resource data provides information about resources, resource use, sacred and ceremonial locations, and overall, evidence of human occupation within and surrounding the park dating to the Late Archaic period (3000 BC – 50 BC).

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

3.3.1 Land Use

Sleeping Bear Dunes National Lakeshore has a substantial amount of wildland-urban interface, both as a result of the park's narrow configuration and encroaching construction and development in the last few decades. The communities of Glen Arbor and Empire border the park. In addition, a number of inholdings and properties developed with cottages, homes, and other structures are located within the park or in close proximity to it. Adjacent land uses include recreational resort, low-density rural residential, agricultural and some forestry. Golf courses and a ski area are nearby.

In recent years, a good deal of second-home or retirement residential development has occurred in the vicinity of Sleeping Bear Dunes National Lakeshore. There is every expectation that this trend will continue, because of the area's recreational opportunities and quality-of-life amenities. Benzie County's population grew by 31% from 1990 to 2000, in comparison to 7% for Michigan as a whole (Census, 2002a); Leelanau County increased by 28% in the same decade (Census, 2002b).

The Lakeshore has been a unit of the national park system since 1970. When land acquisition for the park began, most of the property was in private ownership, with several large tracts held by the State of Michigan. Acquisition progressed steadily, and each year saw a significant portion of land ownership change from private to federal.

During the park's early years, any fires that started were immediately extinguished, usually by one or more local volunteer fire departments before the NPS was even aware that a fire had occurred. It did not matter if the fire was on private or public property. In large part, this practice was dictated by the fact that the parklands were so intermingled with private property. The majority of the recorded fires were of human origin; very few can be traced to natural ignition.

Even though the park now has fee title to the great majority of the lands within its boundary, there are still a number of private inholdings scattered throughout the park. Roughly two-thirds of these are under rights of "use and occupancy" assigned as part of a land acquisition transaction. These rights will expire in the coming years, with the last terminating by the year 2013. The remaining third of inholdings are in private, fee-simple ownership. The ignition potential created by the presence of inholdings is a threat to park resources. Most human-caused fires in the park are in direct proximity to these inholdings.

Key features requiring priority protection from wildfires within the park are the village areas, campgrounds, inholdings, historic buildings (especially on the islands) and radio tower.

The relatively narrow width of most of the mainland portion of the park and the close proximity to other land uses and developed private property, and thus, the perceived vulnerability to wildfires originating within the Lakeshore, are a source of considerable community concern with regard to wildland fire management, as expressed in public scoping for this FMP and EA. Prevailing winds are westerly (both northwest and southwest, depending on the season) most of the year, and since private and developed properties generally lie to the east of the park boundary, they are located downwind of the park. On the other hand, the generally moist climate and broadleaf forests of the area tend to mitigate against large, fast-moving fires on the eastern shore of Lake Michigan.

3.3.2 Human Health and Safety

The smoke, heat and flames from forest fires can threaten human lives and health, both of the public at large and firefighters in particular. The new FMP will include the following safety measures:

a) Employees will wear standard safety clothing when involved in monitoring or suppression actions, or whenever inside an actively burning area. All employees participating in monitoring will be issued copies of the Standard Firefighting Orders and the "Fire Situations That Shout 'Watch Out'".

b) Radios will be assigned to all fire crews and monitors. Special permission must be obtained from the Resource Management Specialist for monitors to work alone on actively burning fires. The Incident Commander will know the position of all personnel on the burn at all times.

c) Patrols will be assigned on all fires to prevent public visitors from entering the burn area and to keep them at a safe distance for any observation activities.

d) Trails providing access to areas involved in fire activity will be closed to public use if fires present unacceptably hazardous conditions to these visitors. Backcountry camping permits will not be issued for areas determined to be hazardous due to fire activity.

e) Safety messages will be incorporated in fire management information disseminated at visitor contact points, and by the Public Information Officer. Interpretive

programs and literature will contain fire safety messages, and information listing fire location, behavior, expected dangers, areas to avoid, and precautions to be taken. These will be posted on park bulletin boards and at the visitor center. This information will also be given to park concessionaires to be disseminated to guests.

f) Smoke warning signs will be placed along park roads to warn drivers of low visibility areas. Roads will be closed or traffic guided as necessary, in conjunction with local county authorities.

g) Initial attack or monitoring team members will determine the proximity of visitors and neighbors to the fire and inform them if a potential hazard exists. Those in need will be assisted in their evacuation if necessary.

On the Manitou islands, the primary health and safety issues concern the visiting public and firefighters. Due to the backcountry nature of the islands an unexpected fire can threaten the safety of visitors. Under extreme conditions, it is possible for visitors or firefighters on the island to be trapped by a fast-moving wildfire, although most campgrounds and developed areas are close to the Lake Michigan shoreline. On South Manitou Island, the current ferry schedule could allow removal of people from the island. The north island is another matter, since the ferry stays only long enough to reload and return to Leland. In both locations visitors might be forced to go to the historic sites for safety.

On the mainland, the main safety threat is to campers or hikers within the unit. To a smaller extent there is a hazard from smoke on the roads running along the lakeshore. For the most part, these roads are not overly wide or straight and they carry a heavy traffic load, especially during the summer months.

3.3.3 Public Services

Nearby local governments provide certain services to local communities, including firefighting, law enforcement, search and rescue, and emergency medical transport services. Of these, the most relevant to the FMP is firefighting. A number of small local, volunteer fire departments provide service to their communities, and also assist the national lakeshore at times, including the Homestead Township Fire Department, Frankfort Fire Department, Solon/Centerville Fire Department, Empire Fire Department, Glen Arbor Fire Department, Leland Fire Department, and Benzonia Township Fire Department. Some of these fire departments offer their services to adjacent communities; Lake Township, for example, contracts with Homestead and Frankfort to provide fire protection services for its residents (Robinson and Catton, 2002).

Lake Township also provides firefighting service to landowners within its jurisdiction, including Sleeping Bear Dunes National Lakeshore (Shultz, 2002). In 2001, three of the seven fires within Lake Township to which the Homestead Fire Department responded were directly related to the Lakeshore (Robinson and Catton, 2002). The federal government provides Payment in Lieu of Taxes (PILT) to reimburse municipalities for federal non-taxable property within their jurisdiction (Shultz, 2002). Michigan received nearly two million dollars in PILT compensation in 2002, of which Benzie County's share was $9,538.

The Lakeshore currently has general agreements with four of the nearby fire departments, outlining respective responsibilities on the National Lakeshore and adjacent private properties. For example, the agreement with the Empire Township Fire and Rescue Department specifies NPS and departmental responsibilities and cooperation in the areas of structural fire, wildland fire, emergency medical services, search and rescue, hazardous materials spills, and all other non-law enforcement emergencies.

Several of these departments have recently benefited from federal assistance from the NPS Rural Fire Assistance program (Shultz, 2002). This assistance has been in the form of donated equipment and federal funds to cooperatively train local fire departments in widland fire suppression techniques. This program started in 2001 at Sleeping Bear Dunes, and one or more local departments have been provided funding each year since.

The Leelanau County government provides a variety of general public services and public safety functions (Leelanau County, no date). For example, in 2001, the Leelanau County Sheriff's Office responded to nearly 10,000 complaints, 351 index crimes, many other situations, and generated 1,665 official reports (LCSO, 2002). The Benzie County government provides similar services for its residents (Benzie County, no date).

3.4 PARK FACILITIES AND OPERATIONS, VISITOR USE AND EXPERIENCE

3.4.1 Park Facilities and Operations

Facilities

Sleeping Bear Dunes National Lakeshore's Philip A. Hart Visitor Center and park headquarters is located in the village of Empire, toward the middle of the park along its north-south axis. Another seasonal visitor center is on South Manitou Island. Other park facilities on the mainland include two ranger stations, several picnic areas, two campgrounds (Platte River and D.H. Day), the Pierce Stocking Scenic Drive and overlooks (SLBE, no date). In addition, other park or nearby facilities that welcome visitors are the DuneCenter, the Sleeping Bear Point Maritime Museum, the Cannery (a historic boat collection), and the historic village of Glen Haven. Between them, North and South Manitou islands contain two ranger stations and four campgrounds. Numerous state and local roads crisscross the mainland portion of the park.

Operations

In FY 2003, the Sleeping Bear Dunes National Lakeshore had a budget of $3.4 million (NPS, 2002g). The Lakeshore usually has 20-25 certified wildland fire fighters on staff for an immediate response to a wildland fire (Shultz, 2002). The park generally receives between $500 and $2,000 annually for wildland fire operation support. Fires in the park typically burn less than 0.1 acre. In addition, the park has fire-fighting equipment and fire pumps, hand tools and specialized vehicles.

The park fire operation is overseen on-site by a collateral duty Fire Management Officer (FMO), with greater support/oversight provided by the full-time FMO located at Indiana Dunes National Lakeshore.

3.4.2 Visitor Use and Experience

Overall the Lakeshore visitation has increased from about three-quarters of a million in the mid-1970's to about 1.2 million in recent years (NPS, 2002g; Karamanski, 2000). The park has an entrance fee and also fees for camping.

Sleeping Bear Dunes is open year-round. The Philip A. Hart Visitor Center is open seven days a week from 9 a.m. to 6 p.m. in the summer and 9 a.m. to 4 p.m. the rest of the year. It is closed only for Thanksgiving, Christmas, and New Years Day. Pierce Stocking Scenic Drive is open from late April through early November from 9:00 a.m. until half an hour after sunset. The Dune Climb is open 24 hours, year-round. The Maritime Museum is open seasonally from 10:30 a.m. to 5:00 p.m., and its grounds are open year-round.

Ferries are available to carry visitors to the North and South Manitou islands during the spring, summer and fall months. The park offers hiking trails, cross-country skiing (101 miles of marked trails), camping, and picnicking opportunities to visitors. Hunting for deer, rabbit, squirrel, ruffed grouse, and waterfowl is allowed in season under Michigan hunting regulations, except near Pierce Stocking Drive and certain developed areas (NPS, no date). Private lodging, cottages and Bed & Breakfast's are also available in the immediate area (Unofficial Sleeping Bear Dunes Home Page, 2002). There are also private campgrounds in the area. Hang-gliding also takes place in the park, and golf and downhill skiing are available nearby.

Figure 5 – Historic structure on South Manitou Island